

13.5: Completely randomized designs.

19. $K=3, n_j=6, N=18$ $\bar{x} = 144$

a. $SSTR = \sum_{j=1}^3 n_j (\bar{x}_j - \bar{x})^2 = 6(156-144)^2 + 6(142-144)^2 + 6(134-144)^2$
 $= 864 + 24 + 600 = 1488$

b. $MSTR = \frac{SSTR}{df} = \frac{1488}{3-1} = 744$

c. $SSE = \sum_{j=1}^3 (n_j - 1) s_j^2 = (5)(164.6) + (5)(131.2) + (5)(116.4)$
 $= 823 + 656 + 582 = 2061$

d. $MSE = \frac{SSE}{n_T - K} = \frac{2061}{15} = 137.4$

e. $H_0: \mu_1 = \mu_2 = \mu_3$
 $H_a: \text{Not all pop. means are equal}$ $\alpha = 0.05$

$F = \frac{MSTR}{MSE} = \frac{744}{137.4} = 5.41$

$F_{0.05}$ with $df_1 = 2, df_2 = 15 \rightarrow F_{0.05} = 3.68$

$F > F_\alpha$ so we reject H_0 ($\alpha = 0.05$).

2c.

α	Source of variance	df	SS	MS	F
	Treatments	2	1488	744	5.49
	Error	15	2031	135.4	-
	Total	17	3519	-	-

b. use FLSD, $\alpha = 0.05$.

Test 1

$$H_0: \mu_1 = \mu_2$$

$$H_1: \mu_1 \neq \mu_2$$

$$\text{test statistic } |156 - 142| = 14$$

$$\text{LSD } \text{LSD}^{12} = 14.32$$

Rejection Don't reject H_0 ($\alpha = 0.05$)

$$\mu_1 = \mu_2 \quad (\alpha = 0.05)$$

No significant difference

Test 2

$$H_0: \mu_1 = \mu_3$$

$$H_1: \mu_1 \neq \mu_3$$

$$|156 - 134| = 22$$

$$\text{LSD}^{13} = 14.32$$

reject H_0 ($\alpha = 0.05$)

$$\mu_1 \neq \mu_3 \quad (\alpha = 0.05)$$

significant difference

Test 3

$$H_0: \mu_2 = \mu_3$$

$$H_1: \mu_2 \neq \mu_3$$

$$|142 - 134| = 8$$

$$\text{LSD}^{23} = 14.32$$

Don't reject H_0 ($\alpha = 0.05$)

$$\mu_2 = \mu_3 \quad (\alpha = 0.05)$$

No - - -

df = 15

$$\text{LSD} = t_{\frac{\alpha}{2}, 0.025} \sqrt{\text{MSE} \left(\frac{1}{n_i} + \frac{1}{n_j} \right)} = 2.131 \sqrt{135.4 \left(\frac{1}{6} + \frac{1}{6} \right)} = 14.32$$

21. $k=5$, $n_j=7 \rightarrow n_T=35$. complete ANOVA table

Source of Variance	df	SS	MS	F
Treatments	$5-1=4$	300	$\frac{300}{4}=75$	$\frac{75}{5.33}=14.07$
Error	$n_T-k=30$	$460-300=160$	$\frac{160}{30}=5.33$	
Total	34	460		

22.

a. $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$
 H_1 : Not all of the pop. are equal.

b. $\alpha=0.05$.

$F_{0.05}$ with $df_1=4$ and $df_2=30$

(2...) $F_{0.05} = 2.69$

(2...) $F > F_{\alpha}$ so reject H_0 ($\alpha=0.05$)

23. $k=3$, $n_T=19$, $\alpha=0.05$.

S.O.V	df	SS	MS	F
Treatment	$3-1=2$	150	$\frac{150}{2}=75$	$\frac{75}{15.63}=4.80$
Error	$n_T-k=16$	$400-150=250$	$\frac{250}{16}=15.63$	
Total	18	400		

$F_{0.05} = 3.59$

$F > F_{\alpha}$ so reject H_0 ($\alpha=0.05$)

24. $k=3, n_T=47$

S.O.V	df	SS	MS	F
Treatment	2	1200	600	43.99
$n_T - k$ Error	44	600	13.64	
Total	46	1800		
$n_T - 1$				

25.

$$\bar{X} = 108.67$$

$$\rightarrow SSTR = 8(119 - 108.67)^2 + 10(107 - 108.67)^2 + 10(100 - 108.67)^2$$

$$= 8(53.67)^2 + 10(27.89)^2 + 10(751.69)$$

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26. $K=3$, $N_T=30$

S.O.V	df	SS	MS	F
Treatment	2	4560	2280	9.87
Error	27	6240	231.11	
Total	29	10800		

$F_{0.05} = 3.35$

$F > F_{\alpha}$

So reject H_0 ($\alpha = 0.05$).

27. $K=4$, $N_T=24$

S.O.V	df	SS	MS	F
T	3	61.64	20.55	17.56
E	20	23.41	1.17	
Total	23	85.05		

$F_{0.05} = 3.1$

reject H_0 ($\alpha = 0.05$).